CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

ANIMAL HUSBANDRY DIVISION

CENTRAL EXPERIMENTAL FARM, OTTAWA

PROGRESS REPORT
1950 - 1954

The daily ration of 127 pounds of grass when cut and piled almost overshadows the cow.

Published by authority of the Rt. Hon. JAMES G. GARDINER, Minister of Agriculture,
Ottawa, Canada.

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ANIMAL HUSBANDRY DIVISION

Progress Report 1950-1954

INTRODUCTION

This progress report gives a brief resumé of the experimental work carried out by the Division at Ottawa in the years 1950 to 1954, inclusive. The previous report was published in 1952 and covered the period 1937-1949.

During the years under review major changes occurred in the professional personnnel of the Division. Mr. Geo. W. Muir, Dominion Animal Husbandman from 1933 until his retirement in January 1951, was succeeded in May 1951 by K. Rasmussen as Chief, Animal Husbandry Division. C. D. MacKenzie severed his connection with the Division in 1951 and S. B. Williams was transferred from the Division in 1952 to become Superintendent, Experimental Farm, Nappan, Nova Scotia.

F. K. Kristjansson, who joined the Division in 1949, was placed in charge of the swine breeding research program in 1952. C. G. Hickman, who was appointed assistant in swine in 1949, completed his post-graduate training in 1953 and was then placed in charge of dairy cattle breeding research. G. M. Carman joined the staff in 1953 to take charge of sheep and beef cattle breeding research while W. J. Pigden joined the staff at the same time to take charge of pasture investigations. S. R. Haskell also came to the staff in 1953 to work in the field of animal nutrition. In October, 1954, J. A. Elliott entered the service of the Division as research officer in dairy technology.

W. H. Hough was appointed assistant in sheep in 1951 but after taking post-graduate work he was assigned to develop physiology research in the Division. V. J. Miles was appointed assistant in dairy cattle management in 1951 and W. A. Jordan replaced B. McCarthy, in 1952, as assistant in beef cattle management.

A gratifying feature of the personnel changes has been the increased level of academic training of staff members. At the time of the previous report there was one staff member with a Ph.D. degree, seven with M.S. or M.Sc. degrees, and one with a B.S.A. degree. At the end of 1954 there were six staff members with Ph.D. degrees, six with M.S. or M.Sc. degrees, and two with B.S.A. degrees.

In the program of research conducted by the Division at Ottawa and co-ordinated for the branch farms across Canada, increasing emphasis has been placed on the use of modern research techniques to improve the efficiency of our work. A major step in this direction has been the growing use of mechanical tabulation in analyzing data. Not only does this provide for analyzing current data but also older data that have accumulated but have not been analyzed previously.

New and improved facilities were made available during the period under review. A new dairy research building was completed and taken into use in 1953. The construction of a new research piggery, especially designed for test work in swine-breeding projects, was commenced in 1954. A new laboratory was equipped in the old dairy building, for use primarily in connection with the freezing of semen used in dairy cattle breeding research. Likewise, space in the large-animal laboratory was arranged and equipped for a small physiology laboratory.

In the detailed report on projects it will be noted that studies on the use of grass silage have been prominent in the beef cattle and dairy management sections. Likewise, increasing emphasis has been given to pasture studies both at the level of pasture management and experimental technique studies. This indicates the importance attached to the role of grass, in its various forms, in the economical production of ruminant animals in Eastern Canada.

Some major new developments have taken place in co-ordinated dairy cattle, beef cattle, and swine breeding research programs and in physiology research. As these are relatively new and results to date are limited, their importance is not indicated fully by the brief reports in the present publication.

BEEF CATTLE

Production and Management Studies

Grass silage vs. corn silage for wintering beef cows

With the growing interest in the curing of forage as grass silage it was felt advisable to determine whether grass silage could replace corn silage when fed with hay. For this purpose two groups of cows, similar in age and weight, were fed a basic ration of hay at the rate of one pound per 100 pounds liveweight. In addition, Group 1 received grass silage and Group 2 corn silage in amounts that ensured that both groups were offered equal amounts of dry matter daily.

The hay and the grass silage contained 90 and 85 per cent legumes, and 10 and 15 per cent timothy, respectively. The average dry-matter content of the silages was 21 per cent. All cows were weighed every 28 days, and the final weight was taken 24 hours after calving. The calves were weighed at birth and graded for vitality and strength.

Cows on permanent pasture after being wintered on grass silage and hay.

On the basis of two years' results the cows fed corn silage practically maintained their weight, while those fed grass silage lost a little over half a pound per head daily over a period of 119 days. Both groups consumed an average of 9·5 pounds of hay daily. In addition, Group 1 consumed 43·5 pounds of grass silage, and Group 2, 44 pounds of corn silage. The average dry matter consumption was the same in both groups, 17 pounds per head daily. This is one pound more than the quantity recommended by feeding standards.

There was little difference in the weight and vitality of the calves at birth. Likewise, the weaning weights of the calves indicated that there were no important differences in the milk production of the two groups of cows.

Consequently, it would appear that the body weight loss of the cows was not serious. On good pasture during the summer the cows regained their body weight in addition to providing sufficient milk for their calves.

In conclusion, it may be said that grass silage is a satisfactory replacement for corn silage, of equal dry-matter content, when fed in conjunction with hay for wintering beef cows. P. E. Sylvestre, W. A. Jordan.

Grass silage and corn silage for wintering beef calves

Past evidence has shown that beef calves will grow and make satisfactory gains during the winter on a ration of hay, corn silage, and a small amount of grain. Grass silage is higher in protein and calcium than corn silage, and these are two primary requisites for growing calves. Because of this it seemed advisable to determine if grass silage would be a more suitable succulent roughage than corn silage in the winter ration of beef calves.

For two consecutive years the available calf crop was divided equally into two lots according to sire, sex, and condition. Both lots were loose-housed and were fed outside. Each lot received an equal amount of mixed legume hay, and a grain ration of 75 per cent ground oats and 25 per cent bran. In addition, one lot received grass silage, and the other corn silage, both fed to appetite. The two-year average gain and feed consumption for the two lots of calves are given in Table 1.

TABLE 1. GAIN AND FEED CONSUMPTION OF BEEF CALVES IN WINTER FEEDING TRIALS

		Lot 1	Lot 2
		Hay, grain, grass silage	Hay, grain, corn silage
Animals per lot	No.	33	33
Average final weight	lb.	519·8	523·2
Average gain per head	lb.	91·1	92·3
Average daily gain	lb.	·79	·80
Feed per head per day—			
Hay	lb.	3·99	3·99
Grain	lb.	1·86	1·86
Silage	lb.	18·69	18·25

At the close of the feeding trial each year both lots had averaged practically the same gain, a little over three-quarters of a pound per head daily. Similarly, the growth, bloom, and development for both lots appeared equally good. Both lots consumed practically the same amount of total digestible nutrients. The average protein consumption for the calves on corn silage, hay, and grain was 0·62 pounds per head daily, while those on grass silage, hay, and grain received 25 per cent more. As the gains were equal for both lots, it appears that the extra protein supplied by the grass silage in this ration was not necessary. W. A. Jordan, P. E. Sylvestre.

The value of grass silage for fattening yearling steers

An increasing amount of grass silage is being made every year in Eastern Canada, to replace hay or corn silage. As the latter roughages are used extensively with grain in the finishing of beef cattle, it was thought advisable to determine the value of grass silage when replacing hay or corn silage.

For two consecutive years 24 Hereford, long-yearling steers were divided into four equal lots and allotted at random to the following roughages: Lot 1, hay to appetite; Lot 2, grass silage to appetite; Lot 3, hay limited, grass silage to appetite; Lot 4, hay limited, corn silage to appetite. In addition, all lots

received a grain mixture of oats and barley with a small addition of linseed oil meal for Lots 1 and 4 to bring the protein content up to standard. All animals had access to a mineral mixture of bone meal and salt. The hay and the grass silage fed was a mixture of grass and legume but the percentage of legumes in the latter was a little higher. The average moisture content of the two silages was the same at 81 per cent. All animals were fed individually and marketed when judged properly finished. Table 2 summarizes the gain and feed consumption.

TABLE 2. GAIN AND FEED CONSUMPTION OF STEERS ON GRASS SILAGE, CORN SILAGE, AND HAY COMPARISON. TWO-YEAR AVERAGE 1951-53.

—		Lot 1	Lot 2	Lot 3	Lot 4
		Hay ——— ——— grain	——— Grass silage, grain	Hay, grass silage, grain	Hay, corn silage, grain
Average number steers	No.	6	6	6	6
Average time on feed	days	124·4	124·1	121·6	123·8
Average final weight	lb.	960·6	982·6	966·2	977·4
Average daily gain	lb.	1·67	1·90	1·79	1·83
Feed per head per day—					
Hay	lb.	10·2	.....	4·1	4·2
Silage	lb.	.....	31·0	19·8	16·8
Grain	lb.	9·2	9·3	9·3	9·2

Statistical analyses show that the differences in gain between the four lots are not sufficiently large to be significant. This indicates that from a practical standpoint any one of the rations can be considered to be equally satisfactory and the choice of feed will depend on production and cost factors. P. E. Sylvestre, W. A. Jordan.

Limited grain for wintering yearling steers to be finished on pasture

The wintering of long-yearling steers on roughage alone is a common practice among beef producers. The purpose is to winter the animals as economically as possible and take advantage of cheap pasture for most of the gain. In order to test the soundness of this practice, two groups of long-yearling steers were wintered, one on hay alone, the other on hay plus two pounds of grain. The hay fed was mixed grass hay with about 14 per cent legume. The grain mixture consisted of equal parts oats and barley. In the spring the steers were placed on pasture together and marketed when finished in late summer or early fall. The experiment was conducted for five years and a summary of the results is included in Table 3.

TABLE 3. GAIN IN DRY-LOT AND ON PASTURE OF STEERS WINTERED ON HAY AND HAY PLUS GRAIN. FIVE-YEAR AVERAGE 1947-1951.

—		Group 1 Hay	Group 2 Hay plus grain
Average number steers	No.	17·2	17·0
Winter feeding—			
Average time on feed	days	157·4	157·4
Average initial weight	lb.	792·1	793·9
Average gain per head	lb.	75·8	132·0
Summer feeding—			
Average number pasture days	No.	149·0	140·5
Average final weight	lb.	1,120·8	1,144·4
Average gain per head	lb.	252·9	218·3
Total gain per head	lb.	328·7	350·3

During the winter Group 2, grain fed, gained 132 pounds per head, while group 1, hay alone, gained only 75·8 pounds, a difference of 56 pounds in favor of the former group. When on pasture the performance of the groups was reversed with the group fed only hay during the winter gaining an average of 253 pounds per head as compared with 218·3 pounds for the group fed hay and grain. However, the difference was not large enough to offset the winter gain made by the grain-fed group. As a result the latter group when marketed in the fall weighed on the average 25 pounds more and was ready for market ten days earlier.

The average hay consumption was 3,398 pounds per head for Group 1, hay alone, and 3,050 pounds for Group 2. The latter consumed in addition 312 pounds of grain per head. During the summer Group 1 was on pasture for 149 days and consumed 295 pounds of grain. Group 2 remained on pasture 140 days and consumed 273 pounds of grain, a total of 585 pounds of grain for the whole experimental period. Charged at the prevailing price for those years, the average feed cost per head was $36.67 for Group 1, and $40.06 for Group 2, a difference of $3.39 in favor of Group 1.

All steers were sold on the basis of quality and finish. The average price obtained for Group 1, farm basis, was $22.49 per 100 pounds liveweight, $23.83 for Group 2, a difference of $1.34 in favor of the latter. The extra weights and the higher value per pound were responsible for an extra profit over feed cost of $18.62 per head for the group fed grain during the winter. P. E. Sylvestre, W. A. Jordan.

Linseed oil meal vs. oats and barley for wintering yearling steers

In a previous experiment it was found that the addition of a limited amount of grain to a ration of hay was advantageous in wintering long-yearling steers. It seemed desirable to determine if a protein-rich concentrate, such as linseed oil meal would be superior to a grain mixture of oats and barley.

For this purpose two groups of steers were wintered on a basic ration of hay consisting mostly of timothy and Kentucky blue grass with a small proportion of alfalfa, vetch, and alsike clover. This was supplemented by 2 pounds of linseed oil meal per head daily for Group 1, and 2 pounds of a grain mixture of equal parts oats and barley for Group 2. Both groups had free access to a mineral mixture of salt and bone meal. The steers were subsequently pastured together and marketed in late summer or early fall.

Two years' results show that for a winter feeding period of 165 days Group 1, fed linseed oil meal, averaged a gain of 132 pounds or 34 pounds more than Group 2, fed oats and barley. During the subsequent grazing period the gains of the two groups were so nearly alike that at time of marketing the linseed oil meal group still was 30 pounds heavier per head.

The average feed consumption of the two groups was the same. However, the linseed oil meal group consumed daily 0·39 pounds per head more digestible protein than the other group. As the hay was predominantly grass and therefore low in protein the extra protein consumed may have been responsible for the higher gain of the group.

From the results it appears that, for wintering yearling steers, the supplementation of a low-protein roughage with two pounds of linseed oil meal may produce greater gain than supplementation with a mixture of oats and barley. However, the cost of each supplement will have to be considered in relation to the gains to determine the relative economy. P. E. Sylvestre, W. A. Jordan.

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The value of aftermath as a substitute for grain for the finishing of two-year-old steers

The practice of grazing two-year-old steers on improved or unimproved permanent pasture is fairly common in Eastern Canada, especially in Ontario. In favorable years, there may be sufficient herbage to bring these animals up to the Commercial and Blue grades, and market them off grass. Most often, however, from August to October these pastures are just about good enough to maintain the steers. As a consequence proper finish cannot be obtained unless grains are fed on pasture or the animals are kept for finishing in dry lot the following winter.

During the years 1951 to 1954, inclusive, an experiment was conducted to determine the value of aftermath as a substitute for grains in the finishing of two-year-old steers, and also as a means of marketing these animals earlier and at a lighter weight.

Each spring two-year-old steers, which had been wintered almost solely on roughage, were placed on a good permanent pasture. The herbage consisted mostly of Kentucky and Canada blue grass, timothy, alsike, and white clover. At the end of August the steers were weighed and those sufficiently finished were marketed. The remainder were divided into two groups on the basis of weight and condition. One group remained on the permanent pasture and was fed in addition an average of 5½ pounds per head daily of a grain supplement made up of oats and barley. The other group was placed on an aftermath consisting largely of wild vetch, alsike clover, a small amount of alfalfa, and timothy. All steers were marketed around the middle of October and all carcasses were graded.

From spring until the end of August the increase in weight was 183 pounds per head, or a daily gain of 1·67 pounds. On the average, about one-quarter of the group was sufficiently finished to be marketed. The summary results of the two experimental groups will be found in Table 4.

TABLE 4. GAIN, CARCASS GRADES, AND RETURNS OF TWO-YEAR-OLD STEERS ON PERMANENT PASTURE PLUS GRAIN AND ON AFTERMATH. FOUR-YEAR AVERAGE 1951-1954.

—		Group 1	Group 2
		Permanent pasture plus grain	Aftermath
Number of steers	No.	48	48
Days on pasture	No.	46·3	46·3
Average daily gain	lb.	1·93	1·83
Grades—			
Red	No.	32	35
Blue	No.	11	10
Commercial	No.	5	3
Dressing percentage—			
(Farm/cold)	%	51·9	52·8
Return per steer over feed cost	$	230·20	244·45

The average final weight was 1,093 pounds for the steers on permanent pasture plus grain and 1,084 pounds for those on aftermath. The dressing percentage and the carcass grades were higher for the steers finished on aftermath alone. The higher average grading of the carcasses and the saving in grain were responsible for an extra profit of $14.25 per steer in favor of the aftermath group.

These results afford conclusive evidence that two-year-old steers can be finished properly on pasture without grain. They emphasize the value of aftermath as a feed and the role it can play in economical summer finishing of

cattle. The more general use of such supplementary pastures under proper management might help considerably to reduce the number of unfinished cattle sent to slaughter every fall. P. E. Sylvestre, W. A. Jordan.

Permanent pasture vs. pasture in a crop rotation for steers

Uniformity of production throughout the season is an important factor in pasture utilization. Past experiments have shown that in the Ottawa Valley and most of Eastern Canada it is impossible to obtain uniform production with permanent pasture grazed continuously throughout the season. Accordingly, the following experiment was undertaken in co-operation with the Field Husbandry Division to determine if a crop rotation for pasture would provide greater and more even production than would permanent pasture.

The experiment was located at Connaught Rifle Ranges on North Gower, clay soil. A twelve-acre field was divided into four three-acre fields and a four-year rotation established, as follows:

First year.—Oats and sudan grass; seeded down to a mixture of clover, alfalfa, and timothy; application of mineral fertilizers; repeated grazing of the oat and sudan grass mixture.

Second year.—Half the area grazed in rotation all summer; the remaining half cut early for hay followed by grazing of the aftermath.

Third and fourth years.—Application of sulphate of ammonia in the spring; same management procedure as in the second-year rotation.

This method of providing pasturage was compared with a four-acre permanent pasture similarly fertilized, but grazed continuously. Yearling steers were used as grazing animals. The data on a per-acre basis for fourteen years are summarized in Table 5.

TABLE 5. COMPARATIVE PRODUCTION PER ACRE OF PERMANENT PASTURE AND PASTURE IN A CROP ROTATION. FOURTEEN-YEAR AVERAGE 1938-1951.

—		Permanent pasture	Rotation of crops
Steer gains	lb.	347	340
Total digestible nutrients grazed	lb.	1,824	1,801
Carrying capacity in S.A.[1]	No.	1·05	1·03
Total digestible nutrients from hay	lb.	.....	416
Total digestible nutrients produced	lb.	1,824	2,217
Increase over permanent pasture	%	.....	21·5

[1] S.A.: Standard Animal—a steer weighing 600 pounds at the beginning of the summer season and 930 pounds at the end. Equivalent to 1744 pounds of digestible nutrients.

The average total digestible nutrient production of the crop-rotation pasture as obtained by grazing was 23 pounds below that of the permanent pasture. Poor drainage and winter killing of the legumes were factors considered to be responsible for the lower production. On the average, 832 pounds of hay were harvested per acre. This is equivalent to 416 pounds of total digestible nutrients or 79·0 pounds of standard steer gain. The average total production of the rotation pasture was therefore 2,217 pounds of total digestible nutrients, an increase of 21·5 per cent over the permanent pasture. This was sufficient to pay for the extra cost of cultivation and leave a net profit of $7.42 per acre when steer gain was valued at $13.24 per 100 pounds.

The use of crop-rotation pasture led to fairly good success in levelling the grass production. On the permanent pasture, 75 per cent of the gain was made during the first eight weeks of the season, 25 per cent in the last

twelve weeks. In the crop-rotation pasture, 50 per cent of the gain was made in the first eight weeks and 50 per cent during the last twelve weeks. It seems logical to assume that the production rate would have been even more uniform had the harvested forage been fed back to the steers. P. E. Sylvestre, W. A. Jordan.

Commercial fertilizer formulae for permanent pasture for beef cattle

High-producing pastures are essential in economical beef production in Eastern Canada. Past experiments have shown that in order to obtain high production, fertilization is necessary. However, there are many different commercial fertilizers on the market and the price of each varies with the amount and kind of fertilizing constituents included. Accordingly in 1938 an experiment was undertaken in co-operation with the Field Husbandry Division to determine the efficiency of different fertilizer formulae for increasing the productivity of permanent pasture grazed with beef cattle.

Four, four-acre fields located on North Gower clay soil were used for this purpose. Field 1 received no fertilizer; Field 2 received 600 pounds superphosphate every three years; Field 3 received the same amount of superphosphate plus 100 pounds of muriate of potash every three years; Field 4 received the same amount of mineral fertilizer as Field 3 but in addition, 100 pounds of sulphate of ammonia added annually in the spring. All fields were grazed with yearling steers. The results for fifteen years, on an acre basis, are summarized in Table 6.

TABLE 6. PRODUCTIVITY OF PASTURES TREATED WITH DIFFERENT COMMERCIAL FERTILIZER FORMULAE AS MEASURED BY STEER GAINS, CARRYING CAPACITY, AND TOTAL DIGESTIBLE NUTRIENTS. FIFTEEN-YEAR AVERAGE 1938-1952.

Treatments		Field 1	Field 2	Field 3	Field 4
		Nil	P.	P.K.	N.P.K.
Steer gains	lb.	227	373	327	351
Total digestible nutrients	lb.	1,200	1,969	1,731	1,847
Carrying capacity in S.A.[1]	No.	0·69	1·13	0·99	1·06
Percentage increase	%	.....	64	43	54

[1] S.A.: Standard Animal—a steer starting at 600 pounds and finishing at 930 pounds after 150 days grazing, equivalent to 1,744 pounds of total digestible nutrients.

It will be noted that all the fertilized fields produced considerably more than the non-fertilized one. The field receiving superphosphate gave the highest production in terms of steer gain or total digestible nutrients. The percentage increase over the non-fertilized one was 64 compared with 54 for the complete fertilizer and 43 for the minerals alone. There was considerable variation in the swards of the different fields. Observation and botanical surveys showed that white clover was strongly predominant in the superphosphate-treated field, and slightly less in the fields receiving superphosphate and potash. In the field treated with complete fertilizer the grasses such as timothy, Kentucky, and Canada blue grass predominated. The same grasses plus a considerable infestation of weeds were noticeable in the non-fertilized field. Differences in the sward had a serious effect on the grazing throughout the season. Where clover predominated, the growth was slower in the spring but lasted longer in the summer, even during the hot days of July. The thick carpet formed by the clovers probably helped conserve moisture by reducing evaporation. The more uniform growth allowed for more uniform stocking. Where the grasses predominated there was very rapid growth in early spring followed by a sharp drop in July and August, when the blue grass went dormant. On these fields productivity was relatively high in May and June but dropped sharply in July and August.

On the basis of return on money invested, the results are slightly different than those from production. For each dollar invested in fertilizers, the superphosphate alone returned $8.31 per acre, the minerals alone $4.37, and the complete fertilizer $2.84. It can be concluded that, on the North Gower clay soils, commercial fertilizers at the rate indicated, when applied to permanent pastures, will give economical results, and that superphosphate alone, because of its lower price and the high yields it produces, is the most economical. P. E. Sylvestre, W. A. Jordan.

Cultivated pasture mixture vs. permanent natural pasture for grazing beef cattle

Experiments have shown that increased production can be obtained by the fertilization of permanent, natural pasture. However, the possibility exists that greater production could be obtained if the pastures were broken up and reseeded. The following experiment was designed and conducted in co-operation with the Field Husbandry Division to test this possibility.

A sixteen-acre block from an old sod was divided into four, four-acre fields. Fields 1 and 2 were plowed and seeded to two different pasture mixtures with oats as a cover crop. The pasture mixture of Field 1 consisted of timothy, 4 pounds; brome grass, 6 pounds; meadow fescue, 3 pounds; red clover, 4 pounds; alsike clover, 1 pound; and ladino clover, 1 pound. That of Field 2 was reed canary grass, 8 pounds; meadow fescue, 3 pounds; red clover, 4 pounds; alsike clover, 2 pounds. The other two fields designated as 3 and 4 were left as natural permanent pastures. All fields except 4 received an application of commercial fertilizer. A crop of hay was taken off the first year and then all fields were submitted to continuous grazing with two-year-old steers during each grazing season. For the three years the experiment was conducted Field 1 produced 50 per cent, Field 2, 38 per cent, and Field 3, 33 per cent more than Field 4, the unfertilized field. On the other hand, using Field 3, the fertilized permanent pasture as point of comparison, it was found that Field 1 produced 13 per cent, and Field 2, 3·4 per cent more.

The timothy-brome, etc. mixture of Field 1, had the best appearance in spite of the fact that most of the legumes were winterkilled during the first winter. There was more ground cover than in Field 2. The reed canary grass mixture of Field 2 was deceiving. Growth started early in the spring, resumed quickly after grazing, but did not produce the gain which the appearance of the pasture might lead one to expect.

On the basis of the returns obtained in this experiment it appears that wherever possible the breaking of permanent pasture and reseeding with the brome grass mixture is an economical procedure. P. E. Sylvestre, W. A. Jordan.

DAIRY CATTLE

Breeding Studies

Herd studies after 30 years of breeding

Analyses of production records collected from the Experimental Farms Ayrshire and Holstein herds indicate that no real improvement in level of production has been achieved through breeding during the past thirty years. Although other studies have shown that level of production is partly inherited the theoretically expected genetic gain is not attained easily. This conforms to the general picture of results from other breeding studies.

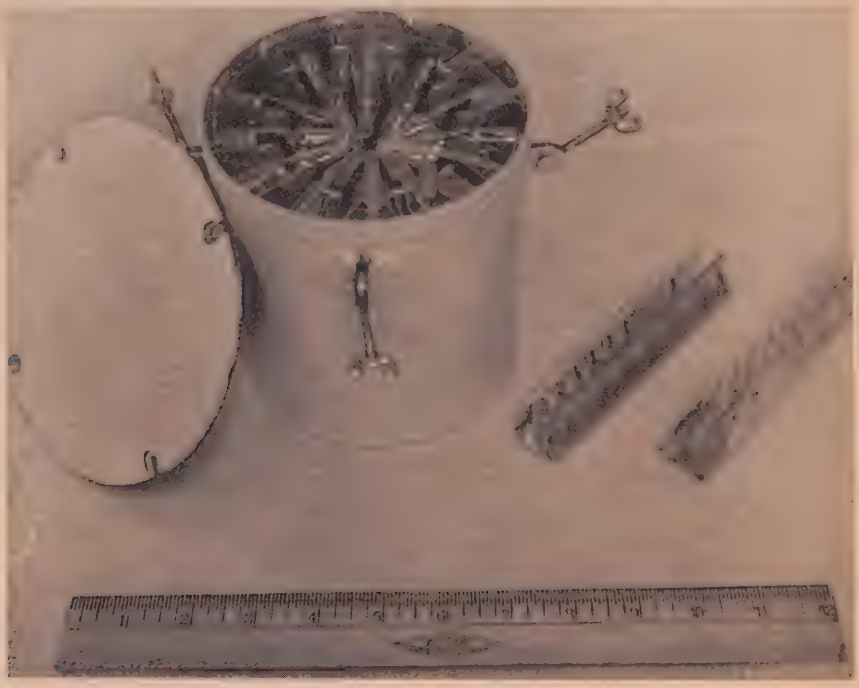
From the records at hand it is impossible to determine how much emphasis has been placed on traits other than level of production. However, it is known that other traits, such as type, were considered and this resulted in

less than maximum improvement of production. It also is possible that, in the herds studied, a genetic plateau has been reached and only new basic knowledge of genetics can lead to further improvement.

In the herds under study male selection has been hampered by herd size. With only one or two males being used at a time the limited opportunity of selecting among sires has prevented the detection of the really good bulls. At times when the number of bulls was increased the reduced number of daughters per bull with fixed herd size prevented reliable estimates of the bulls' breeding values. As bulls were introduced from other herds much variation in the performance of progeny became noticeable. Thus pedigree estimates of bulls with records made in other herds introduce a weak point in our present herd-sire system of breeding. This has been explained by the fact that environmental differences in level of production are so large that the choice of breeding stock from outside herds can rarely be accomplished on a genetic basis. C. G. Hickman.

Artificial insemination enables greater rates of genetic improvement

Co-operation with private herd owners in the use of the same bulls has improved the accuracy of estimating breeding values and the selection of superior breeding stock. In recent years two bulls from the Ottawa herd have gained wide popularity in artificial insemination units because of their ability to get high-producing progeny.



One hundred and twenty ampoules of frozen semen can be shipped in this can when it is buried in dry ice inside the large shipping box shown opposite.

Development towards bringing all Experimental Farm herds under one breeding research program has been made possible with the discovery by English workers that bull semen can be frozen and stored for many months. A laboratory for freezing semen has been developed within the Division and facilities have been developed for shipping frozen semen to Branch Farms and

storing it there for use. With these and similar techniques our knowledge of dairy cattle improvement will expand and better cattle should result. C. G. Hickman.

Shipping box for frozen semen. It can be used also for storage by the regular addition of dry ice.

Research on the estimation of breeding values

Age at lactation has been found to be one of the main factors affecting level of milk and fat production. This has been recognized for many years but objective procedures for taking it into account in Experimental Farm herds have not been used. A detailed study was made of how lactation records, started at different ages, could be compared to give accurate estimates of producing abilities. Results indicate that change in level of production with age is curvilinear and correction of records on young and old cows is necessary for comparison with yield at the prime age of life. Measuring age in months has been found to be sufficiently accurate both from a genetic and practical standpoint. However, correction for age within sequence of lactation would yield additional accuracy in the comparisons.

The "age correction" problem appears complicated by the results of a study made by the author at Cornell University. These results indicate that the relationship between age and yield changes with average level of herd production. Thus, in high-producing herds when standard age corrections are used, it is relatively easy for young animals to rank high, but in low-producing herds young animals are seriously discredited. With data from all Experimental Farm herds this problem is to be dealt with in more detail.

The effect of season at time of freshening also has been found to affect level of production but not to the same extent as does age at freshening. However, it has been determined that two cows of equal breeding value could

very easily differ by 10 per cent in level of production if one freshened in the spring or summer and the other in the fall or winter. Obviously this confuses any attempt to select the best-producing cows or bulls on the basis of progeny records unless allowance is made for season of freshening. Using records from the Experimental Farm herd at Ottawa it has been shown that the correction for this seasonal variation in age can be simplified because the seasonal effect of production is the same for all years. Thus season and age correction can be applied simultaneously. C. G. Hickman.

Feeding and Management Studies

Methods of feeding milk to young dairy calves

It has been claimed that calves fed milk from nipple pails are less subject to digestive scours, due to being forced to drink at a slower rate, than calves fed from an open pail. It has also been suggested that calves stretching their necks to drink from a pail at floor level might force milk through the esophageal groove into the rumen and thus cause improper digestion.

A study of these factors was made with newborn calves allotted at random within breed and sex into three groups. Group 1 was fed milk from an open pail supported above floor level at a height approximating that of a cow's teats, Group 2 was fed from an open pail at floor level, and Group 3 was fed from a nipple pail at udder level. Apart from the methods of feeding the milk all calves received similar treatment.

TABLE 7. THE EFFECT OF FEEDING MILK BY DIFFERENT METHODS ON GAINS AND HEALTH OF DAIRY CALVES.

—		Group 1 Open pail at udder level	Group 2 Open pail at floor level	Group 3 Nipple pail at udder level
Number of calves	No.	13	11[1]	13
Holsteins/Ayrshires	No.	7/6	7/4	7/6
Males/females	No.	5/8	4/7	9/4
Average birth weight	lb.	89	88	88
Average weight at 6 week	lb.	145	143	142
Average final weight (16 week)	lb.	255	250	255
Average gain (16 week)	lb.	166	162	167
Number cases digestive scours	No.	2	2	1

[1]Two calves allotted to this group died shortly after birth. Their deaths were not influenced by the experiment.

A summary of the results is given in Table 7, which shows the data for the three treatments to be quite similar and hence no advantage was apparent for one treatment over another under the conditions of this experiment. V. S. Logan.

The effect of feeding an antibiotic feed supplement (Aureomycin) on the growth rate of dairy calves

A study was made to determine if any practical advantage might be derived from providing an antibiotic feed supplement (aureomycin) in the milk versus mixing it in the meal fed to young dairy calves. The possibility of each treatment having a different effect at different ages of the calves was studied by subdividing the 12-week duration of the experiment into two sub-periods of six weeks each. A final weight was taken at 14 weeks of age to determine any residual effects after discontinuance of the antibiotic. Digestibility determinations were made on the calf rations fed with and without antibiotic. Forty calves were used for the experiment. Two lots of 16 calves

each were allotted at random to four feeding treatments in which a control ration without antibiotic (Ration A) was compared with feeding the antibiotic supplement, in the milk for 12 weeks (Ration B), in the milk for a 6-week period (Ration C), and in the meal from the beginning of meal consumption (2-3 weeks) through 12 weeks (Ration D). The antibiotic feed supplement (trade name Aurofac) was fed at a rate to provide 10 to 12 mg. of aureomycin per calf daily. Two groups of four calves each were used for digestibility studies. These calves were fed at a similar rate to the calves on the feeding trial. One group of four calves received the antibiotic while a similar group served as a control.

Under the conditions of this experiment no significant growth stimulus was caused by the antibiotic. Thus no differences between the methods of administering the antibiotic were apparent. The few cases of scours were no more prevalent in one lot than another. It was not possible to demonstrate any influence of the antibiotic on the digestibility of the rations. V. S. Logan, V. J. Miles.

The protein requirement of calves from birth to eight weeks of age

This experiment was conducted to determine the level of protein required to promote optimum growth in young dairy calves from birth to eight weeks of age.

Four groups of eight calves were allotted to four filled-milk diets containing 13·4, 19·0, 24·3, and 29·7 per cent protein, expressed as a percentage of the dry matter. The calves used were of the Holstein and Ayrshire breeds.

The calves were housed in individual concrete-floored pens bedded with wood shavings. All calves were offered four pounds of colostrum per day for the first three days after birth and then were assigned to their respective diets. Each calf was fed at the daily rate of eight per cent of its birth weight for the remainder of the first week. The daily rates of feeding for subsequent weeks were as follows: 10 per cent of body weight for the second week, 12 per cent of body weight for the third and fourth weeks, and 14 per cent of body weight from the fifth through the eighth week.

Each calf was fed twice daily with equal portions of its daily quota. The milk fed was steam heated to 43°C. before feeding. Each calf was muzzled in order to avoid the possibility of its eating any extraneous material. Water was given ad libitum.

The preliminary results of this study indicate that optimum growth was obtained from one to four weeks of age on a diet containing 24 per cent of the dry matter as protein and from four to eight weeks of age on a 19 per cent protein diet. Complete analysis of the data obtained from this study will be published later. S. R. Haskell, V. J. Miles, and V. S. Logan.

Development of a ration formula for calves on limited milk feeding

The project reported here was designed to establish a ration formula, utilizing feed ingredients common to Canada, that would adequately supply the requirements of calves fed a limited amount of whole milk.

The project was conducted in two phases using 32 and 16 calves respectively for the first and second phases.

In the first phase of the experiment the simplest calf starter from a series of all-plant protein formulae tested by Cornell University, N.Y., was compared with a similar formula in which corn was replaced by an adjustment in the oat and barley content of the meals used. This adjusted formula was designated as the C.E.F. starter. Using a 2 x 3 factorial design a further comparison was made as to the possible advantage of continuing calves on

reconstituted skim milk through the twelfth week versus gradually reducing whole milk feeding from the fourth week and discontinuing it at the end of the seventh week. Half of the calves on each meal formula received antibiotic supplement containing 3·6 gm, aureomycin per pound. Each calf received on the average a total of 360 pounds of whole milk including colostrum.

The results for this first trial indicated the following:

1. Gains on the starter formula in which corn had been replaced by oats and barley were significantly lower than when corn was fed during the first six weeks.

2. From six to twelve weeks' gains on the two meal formulae differed only slightly.

3. Calves fed the starter containing corn consumed more of it and also more hay than those on the adjusted formula.

4. Continuing calves on reconstituted skim milk (36 pounds powder consumed) resulted in significantly higher gains but a reduction in starter and hay consumption.

5. The inclusion of aureomycin in the starter caused appreciably higher gains during the first six-week period. The difference was less pronounced during the second six weeks.

6. The consumption of hay and meal was greater with the group receiving antibiotic.

7. The incidence of scouring was negligible and no more prevalent in one group than another.

The gains for all treatments in the first phase of the experiment were above established averages for breed and age. These results suggested that a further economy in the whole-milk allowance might be effected. Also if a meal formula containing fewer ingredients gave equal results it would be advantageous in practical feeding.

In the second phase of the experiment the C.E.F. starter of the first phase was compared with a ration simplified by reducing the number of ingredients it contained. The rations compared are shown in Table 8.

TABLE 8. ALL-PLANT CALF STARTERS USED WITH LIMITED AMOUNTS OF MILK.

Feed Ingredients	C.E.F. Starter	Simplified Starter
	lb.	lb.
Oat meal or rolled groats	14·75	25·00
Crushed barley	10·00	20·00
Crushed oats	20·00	.....
Wheat bran	15·00	15·00
Linseed oilmeal	10·00	31·95
Soybean oilmeal	18·20	.....
Molasses	5·00	5·00
Alfalfa meal	5·00	.....
Irradiated yeast	0·05	0·05
Ground limestone	0·50	.....
Salt (Cobalt iodized)	0·50	1·00
Bone meal	1·00	2·00
	100·00	100·00

Whole milk fed through seven weeks was compared with changing over to reconstituted skim milk during the second week and continuing on reconstituted milk through the seventh week. Half of the calves received antibiotic feed supplement (aureomycin) included in the meal ration at 0·5 per cent.

The results from this phase of the experiment were as follows:

1. Calves fed the simplified starter made gains equal to those on the more complex C.E.F. starter during the first six-week period and slightly better gains during the second six-week period.

2. Calves which received an average total allowance of 66 pounds of whole milk and 34·4 pounds of skim milk powder (reconstituted) made as good gains as those which received a total of 344 pounds of whole milk.

3. The average daily gain for calves fed antibiotic was approximately 20 per cent higher than when no antibiotic was fed.

4. More hay was consumed by calves receiving the simplified meal ration, reconstituted skim milk, and antibiotic than by their opposite numbers.

5. The calves which were fed reconstituted skim milk consumed almost twice as much starter as did the calves fed whole milk. Feeding antibiotic appeared to stimulate meal consumption.

6. The few cases of scours which occurred appeared not to be influenced by treatment. V. S. Logan, V. J. Miles.

Grass silage in dairy heifer rations

Sixteen Ayrshire and Holstein heifers, approximately one year of age, were used to compare (*a*) grass silage fed with hay and meal, (*b*) grass silage supplemented with meal, (*c*) grass silage fed alone, and (*d*) hay supplemented with meal. Silage was fed alone at the rate of six pounds and with hay at the rate of three pounds of silage and one pound of hay per 100 pounds live weight daily. Meal was fed at the rate of one-half pound per 100 pounds live weight daily.

Botanical analysis of the hay indicated that it contained 65 per cent legumes and 35 per cent grasses. The silage was of similar composition and averaged 26 per cent dry matter. The meal mixture contained approximately 12 per cent digestible protein.

The experiment was of change-over design which extended over four 28-day experimental periods. The results are summarized in Table 9.

TABLE 9. THE EFFECT OF FEEDING GRASS SILAGE ON DAIRY HEIFER GAINS (MEAN VALUE PER GROUP OF FOUR HEIFERS FOR A 28-DAY PERIOD).

	Ration A	Ration B	Ration C	Ration D
	Meal Hay Silage	Meal Silage	Silage	Meal Hay
	lb.	lb.	lb.	lb.
T.D.N. consumed	986·3	889·2	625·8	996·7
Body gain	140·5	152·5	26·3	126·5
T.D.N. consumed per pound gain	8·9	5·9	11·9	9·3

The results of this short-term experiment indicate that silage can replace hay to advantage when fed with a small amount of meal supplement to growing dairy heifers. Silage fed alone did not provide adequate nutrients (feeding standard requirements approximately 800 pounds) and resulted in gains and efficiency below average for the experiment. The differences for nutrient consumption and body gains in Table 9 were statistically significant. The differences in efficiency of utilization (T.D.N. per pound gain) were not significant. V. S. Logan.

Supplementing grass silage roughage

Twelve cows in the early stage of lactation were used in a double switch-back trial to study suitable supplementation of grass silage. The following four rations were compared for efficiency of milk yield and maintenance of body weight:

Rations	*Daily rate of feeding*
A. Grass silage	3 pounds per 100 pounds live weight.
Hay	1 pound per 100 pounds live weight.
Concentrate	According to Morrison's feeding standard.
B. Grass silage	6 pounds per 100 pounds live weight.
Concentrate	According to Morrison's feeding standard.
C. Grass silage	6 pounds per 100 pounds live weight.
Concentrate	One-half of Morrison's feeding standard
D. Grass silage	6 pounds per 100 pounds live weight.

The hay and silage were estimated to contain 65 per cent legumes and 35 per cent non-legumes. The concentrate mixture was composed by weight as follows: ground oats, 4 parts; ground barley, 2 parts; wheat bran, 2 parts; malt sprouts, 1 part; ground soybeans, 1 part; and linseed oil meal, 1 part. The digestible protein content of the concentrate was calculated at 14·1 per cent, of the hay at 6·1 per cent, and of the grass silage at 1·8 per cent. The silage contained 26 per cent dry matter.

The results based on four experimental periods of four weeks each are summarized in Table 10.

TABLE 10. EFFECT OF GRASS SILAGE AND SUPPLEMENTARY FEEDING ON PRODUCTION AND MILK COMPOSITION (MEAN VALUES PER COW FOR A 28-DAY PERIOD).

Ration designation		Ration A	Ration B	Ration C	Ration D
Ration ingredients		Silage Hay Full grain	Silage Full grain	Silage Half grain	Silage
Feeding Standard Requirements (T.D.N.)	lb.	514	501	504	454
Actual T.D.N. consumed	lb.	451	426	334	241
Fat corrected milk (4%) produced	lb.	860	861	816	667
Change in body weight	lb.	+30	−1	−10	−58
Solids not fat in milk	%	8·6	8·6	8·5	8·4
Butterfat	%	3·7	3·8	3·6	3·8

While final conclusions may not be drawn from a single trial of this nature, the results shown in Table 10 are similar to those of other workers. Silage fed with a standard grain allowance was equal to silage and hay plus a standard grain allowance for milk production. Reducing the grain supplement to half of the standard allowance resulted in a five per cent reduction in milk yield. Removing the grain supplement completely resulted in a further 18 per cent reduction in production and a serious loss in body weight. Under the conditions of this experiment milk composition was not significantly affected by the different rations fed. V. S. Logan.

Stage of maturity of grass silage influences milk production

A mixture consisting of approximately 90 per cent legume and 10 per cent timothy was harvested at two stages of cutting. The first cutting was made when the alfalfa was in the bud stage and the second cutting was harvested when the alfalfa had reached full bloom. The cuttings were stored in separate tower silos.

Twelve cows in the early stage of lactation were used for the feeding trial. These were divided into three groups of four cows matched as closely as possible within groups for age, body weight, stage of lactation, and milk production. The following four rations were compared by means of a double change-over design of experiment:

Ration	*Meal*	*Silage*	*Hay*
A	11·5% dig. protein	Full bloom cut	Legume
B	8·5% dig. protein	Full bloom cut	Legume
C	11·5% dig. protein	Bud stage cut	Legume
D	8·5% dig. protein	Bud stage cut	Legume

Two levels of protein were fed in the meal concentrate to determine if any differences in the two cuttings of silage might be due to crude protein content of the silages.

Arrangement for individual feeding of dairy cows on feeding trials.

Silage was fed at the rate of five pounds and hay at the rate of one-half pound per 100 pounds live weight daily. The concentrate was fed according to Morrison's standard for "Usual" feeding. The experiment was conducted over four experimental periods of four weeks each during which each cow received each of the four rations. Digestibility determinations on the two silages were made with steers at the same time.

The milk production during the feeding of grass silage cut in the bud stage was significantly higher than when cut in the full-bloom stage of maturity. Because concentrate feeding was adjusted to the level of production the higher yield on the early-cut silage was also associated with a higher nutrient intake largely supplied by the concentrate. The higher nutrient intake could not account for all of the increased production stimulated by the silage cut in the bud stage. Feeding concentrate composed of three parts oats and two parts barley and containing 8·5 per cent digestible protein with grass silage gave as

high yields as when the concentrate supplement contained three per cent more protein. The milk yield was consistently higher with the low-protein supplement fed with both early and late cut silage, although the difference was not statistically significant. The digestion coefficients as measured on steers and the chemical analysis of the two silages did not differ markedly. V. S. Logan.

The effect on yield and composition of milk of rations varying in relative protein and energy content

There has been a tendency for dairymen to feed concentrates with a protein content in excess of requirements, in the belief that the high protein increased milk yields. It has been suggested in explanation of such a belief that the nitrogen fraction is separated from the excess proteins in the alimentary tract and that the energy fraction thus released may be the stimulus to production. If such is the case considerable waste can take place through extravagant use of high protein feeds.

In order to more accurately determine the influence of the level of protein relative to the energy content of the dairy ration on milk production four rations were compared in which normal and high protein levels were each fed with high and low energy. Twelve cows in the early stage of lactation were used in a double switch-back trial extending over four experimental periods of four weeks each. The digestible protein in the high protein ration was brought to 28 per cent in excess of requirements by the addition of linseed oil meal to a basal concentrate of oats and barley. The high- and low-energy rations, 18 per cent above requirements and 10 per cent below requirements, respectively, were obtained by the addition of cane molasses to the basal concentrate fed in adjusted amounts with liberal grass silage and limited hay feeding. Concurrent digestibility trials were conducted with steers on the rations used.

The results showed that the highest milk yields were obtained when the ration containing a high level of protein also contained a high energy complement. The ration containing a high level of protein with low energy value did not stimulate milk yield so effectively as did the rations high in energy with normal protein content. The energy fraction of the rations had a greater net influence on milk yields than did the protein level despite inverse effects of the ration ingredients on their digestibility. The apparent effects of the rations on the composition of milk samples taken during the experimental periods were that the percentages of fat and solids-not-fat were not affected but both the protein and energy of the rations influenced the protein content of the resultant milk.

The trends indicated in this change-over experiment were highly significant. A further test of these results will be made. V. S. Logan, V. J. Miles.

Acceptability of various silages by dairy cattle

Much research is presently being conducted to evaluate various methods of ensiling pasture herbage as a feed for dairy stock. With a view to determining how the techniques and preservatives employed in making grass silage affect the acceptability of the silages when fed to cattle, a preminary trial was conducted at Ottawa in 1954 with sixteen, bred, dairy heifers. Four silages were used of which three had been cured at different pressures and the fourth with SO_2 added as a preservative. For this palatability comparison, time and consumption records were kept for each of the silages being offered free choice to four groups of four heifers each.

The results indicated that as the density to which silage was compacted increased, the palatability increased as measured by the amounts consumed

in a given time. Silage to which SO_2 was added was consumed more readily than untreated silage of the same compaction. These trends were significant under the conditions of the trial.

From this preliminary project it was concluded that consumption data proved useful in the determination of palatability indices. Due to variability between individuals, time spent in eating could not be used to establish palatability ratings under practical conditions. V. J. Miles, C. G. Hickman.

Fresh daily grazing versus free range grazing for dairy cattle

A system of pasture management termed "fresh daily" grazing was compared with the usual free range method of pasturing. Cows in the early stage of lactation were allotted to four plots which provided a replicated comparison of the two systems. While a six-acre area was provided for each plot, the cows on each "free range" plot were limited to four acres grazing in the early season. The management procedure on the "fresh daily" grazed plots consisted of confining the cows daily, by means of electric fencing, to an area of fresh pasture from which they would graze the forage completely.

Dairy cattle awaiting fresh daily pasture allotment. The single-wire electric fence is effective and can be moved very easily.

The stocking rate for this method ranged from an extreme of 130 cows per acre during lush growth to 30 cows per acre in the advanced season during a dry period. Cows on the daily grazing system were allowed to graze back over the allotted ground for six days after which an electric fence was moved up to the rear of the grazing area to permit of aftermath recovery.

Surplus grass on the plots grazed "fresh daily" (varying up to one-half of the six-acre plots) and two acres from each of the "free range" plots was stored as silage from early-season cutting. Subsequently the aftermath of the "free range" plots was required to maintain the seven head of cows per plot for the remainder of the season while a second cutting of surplus grass was recovered from the "fresh daily" plots.

The productivity of the pastures under the two systems of management was compared by converting the yields of forage, whether consumed by the cows or harvested, to total digestible nutrients. The amount of forage consumed by the cows was estimated by a reverse calculation based on the nutrient requirements for maintenance and milk production. This was added to the nutrient value of the cut forage established from chemical analyses of samples taken during the season. Three years' results for the two systems compared on this basis are shown in Table 11.

TABLE 11. COMPARISON OF THE PRODUCTIVITY OF "FRESH DAILY" AND "FREE-RANGE" GRAZED PASTURES, FOR 1952, 1953, AND 1954 ON A PER ACRE BASIS.

Observation		1952		1953		1954	
		Fresh daily	Free range	Fresh daily	Free range	Fresh daily	Free range
Average daily gain, milking cows, per head	lb.	0·48	1·17	0·51	0·34	0·20	0·16
Milk per head per day	lb.	30·6	31·0	30·5	28·5	32·8	32·8
Total digestible nutrients produced per acre	lb.	4,180	4,013	3,664	2,984	4,288	3,378
Percentage increased yield of fresh daily over free range	%	4·2	.....	22·8	.....	26·9	.....
Carrying capacity in animal units per day for 150 day season	A.U.	1·74	1·67	1·53	1·25	1·79	1·41

General observations from the results to date are that while overall milk yields are not increased with "fresh daily" grazing management over "free range", the level of production is more uniformly maintained throughout the season with the former system.

The "fresh daily" grazing showed the greatest advantage in herbage productivity during a season of poorly distributed rainfall and the least advantage during a season of uniform rain distribution. V. S. Logan, V. J. Miles.

SHEEP

Breeding Studies

Open- vs. close-faced Shropshires

Excessive face cover in the ewe is generally considered to be detrimental to the well-being and production of the individual. While this is most apparent in range country it may also be a liability in the Down breeds maintained under general farm conditions. Extreme face cover impairs grazing ability and lowers the general productivity of the animal. Wool-blind sheep are prone to be timid, and this renders them more difficult to handle when in their winter quarters.

This excessive face cover must be removed by clipping at least two or three times during the year, entailing increased costs due to handling. There is a suspicion among sheep raisers and research workers that deliberate selection for the show-ring "fad" of excess face cover, particularly in Shropshires, has been emphasized at the expense of milking ability, robustness, scale, and vigor.

In England strains of Shropshires have been maintained that have not been selected along American standards, and have retained many of the original desirable features.

The Shropshire ewe flock at the Central Experimental Farm, Ottawa, was divided into two groups on the basis of face cover, one lot consisting of those ewes with the least face cover, the other of those with the most. The lot with least face cover was bred to British-type, imported, open-faced rams, while the breeding and seleciton in the other was along close-faced lines. Lifetime production records were kept on all ewes.

The ewes were maintained under typical Eastern Canadian conditions, wintering indoors with good quality hay as the principal roughage, and summering on blue-grass pasture.

Close-faced (left) and open-faced (right) shearling, Shropshire, rams showing difference in type and conformation as well as in face cover. The ram on the left had had the wool sheared from around the eyes so that it could see.

Lambs were weaned in early August, shearling and older ewes were graded for face cover prior to going into the breeding lots.

The lamb production of both types of Shropshires is presented in Table 12.

TABLE 12. LAMB PRODUCTION OF OPEN AND CLOSE-FACED SHROPSHIRES (MEAN BIRTH, 14 DAY, 28 DAY, WEANING, AND YEARLING WEIGHTS).

Type	No.	Birth weight	14 day weight	28 day weight	Weaning weight	Yearling weight
		lb.	lb.	lb.	lb.	lb.
Open-faced	214	9·4	17·3	23·3	69·0	99·0
Close-faced	152	8·0	14·8	19·9	55·5	83·0
Advantages of open-faced type		1·4	2·5	3·4	13·5	16·0

The open-faced ewes excelled the close-faced in all phases of lamb production. Not only were the open-faced-sired lambs heavier at birth but they increased this advantage as they matured. In addition, the mortality rate among lambs prior to 28 days of age was 20 per cent in the close-faced type while only seven per cent in the open-faced.

Fleece and ewe weights and face cover scores are presented in Table 13.

When the flock was divided in 1948, there was no difference in average weight between the two groups. As the experiment progressed a consistent increase in average body weight could be observed in the open-faced group. This was despite the fact that some of the ewes in the initial division remained in the project throughout its time, thus tending to minimize any cumulative effect that was being established.

TABLE 13. BODY WEIGHTS, FLEECE WEIGHTS, AND FACE COVER OF EWES BY YEAR AND TYPE

Face type	Body weight		Fleece weight		Face cover score[1]	
	open	closed	open	closed	open	closed
1950	138·5	128·1	6·7	6·9	.....	.....
1951	119·2	116·2	5·3	6·3	3·3	4·7
1952	139·5	122·2	6·9	6·0	2·7	4·3
1953	146·9	123·9	6·7	6·9	2·1	4·6
1954	141·7	131·3	6·6	6·4	3·1	4·5
Average	137·2	124·3	6·4	6·5	2·8	4·5

[1] Scores ranged from 1 to 5 with 1 being bare face and 5 being completely wool blind.

The open-faced, British type of imported ram is definitely larger in scale and weight than the better known close-faced, or American, type of Shropshire. Size differences between mature rams of the two types are considerable, and it is possible that due to this difference in size, rather than actual face cover, the results shown were obtained.

No differences in grease fleece weights were apparent between the two types, and face cover did not seem to vary greatly over the period discussed. G. M. Carman.

Crossbreeding for the production of market lambs

Market lamb production is the primary source of revenue in the Eastern Canadian sheep industry. It is desired to have these lambs marketed off grass, and for such a program early maturity, coupled with fast growth rate, is required. High milk production and prolificacy are required in the ewe, together with good conformation in the lambs.

In most Eastern Canadian sheep flocks a general system of "grading up" to purebred rams is followed, with several of the Down breeds being used. The full utilization of a planned crossbreeding program is seldom realized, and the hybrid vigor expected from crossbreeding is rarely attained. Since crossbreeding on a definite basis has proved so successful in other countries for the production of market lambs, a planned experiment, using the most popular Down and Longwool breeds, was set up to study the relative merits of the various breed crosses.

Three Branch Farms in Quebec, Normandin, Ste. Anne de la Pocatiere, and Lennoxville, co-operated with the Central Experimental Farm on this project. They made most of the original crosses, sending the ewe lambs to Ottawa for testing.

The crosses involved included the three breeds most popular in Canada at that time—Oxford, Shropshire, and Leicester—plus a small representation of a new breed in Canada, the North Country Cheviot. First-cross ewe lambs were overwintered at Ottawa, and put into the breeding lots as shearlings.

At breeding, the crossbred ewes were randomly assigned, on an age and weight basis, to representative rams of the Southdown, Shropshire, and Suffolk breeds, with the resulting three-way-cross lambs being marketed.

The production of the crossbred ewes is presented in Table 14.

Differences between the various crosses were not large when considered on an overall basis. Lambing percentages were good in all lots. In mortality to 28 days, which was approximately the time the ewes and lambs were put to pasture, the Leicester × Cheviot and Cheviot × Leicester ewes were definitely superior.

Because all lambs were marketed at weaning, or at a minimum of 80 pounds if in satisfactory market condition, there were no practical differences in the weights at which the various crossbred lambs went to market, but the percentage of "A" grade carcasses varied widely. These differences were probably largely due to lack of finish rather than conformation, and reflected the lateness of maturity of some of the breeds tested.

The three breeds of rams compared when bred to the crossbred ewes have their data presented in Table 15.

TABLE 14. AVERAGE WOOL, LAMB, AND LAMB MARKETING DATA OF CROSSBRED EWES.

		N.C. Cheviot[1] × Oxford	Oxford × Shrop.	Leic. × Shrop.	Leic. × Chev.	Chev. × Leic.	Leic. × Oxford
Ewes—							
Bred	No.	27	116	198	45	139	52
Lambed	No.	27	93	181	41	116	46
Average fleece weight	lb.	6·7	7·1	6·9	6·8	6·7	8·5
Lambing percentage[2]	%	140·8	147·3	159·5	163·4	160·4	152·1
Lambs—							
Born	No.	38	137	281	67	186	59
Average birth weight	lb.	8·2	9·2	8·3	8·7	8·8	7·2
Average gain to 28 days	lb.	14·9	14·4	13·9	12·8	13·7	15·7
Mortality to 28 days	%	21·1	14·6	16·4	7·5	9·1	11·9
Marketing data—							
Number	No.	24	111	216	56	156	39
Average age in days	days	184·7	204·6	202·4	204·9	196·2	209·9
Average market weight	lb.	83·8	86·9	83·7	84·2	84·7	86·4
A.D.G.	lb.	0·45	0·40	0·38	0·41	0·40	0·38
Dressing per cent	%	47·6	46·2	46·5	48·1	47·5	44·3
"A" grade carcasses	%	70·0	70·0	89·0	79·0	82·0	54·0

[1]Two years data only. [2]Lambs born over ewes lambed.

The Suffolk breed, as a sire of market lambs from crossbred ewes, was definitely the superior breed tested. While the mortality of the Suffolk-sired group was higher than for the groups sired by Shropshire or Southdowns, the birth weights, gain to 28 days, weaning weights, and market data all clearly illustrate the superiority of this breed for this purpose.

The rate of gain of the Suffolk-sired lambs was reflected in the early age at which they were marketed. The higher weights of these lambs at marketing were mainly the result of weaning lambs at over the eighty-pound weight.

The percentage of "A" grade carcasses was definitely best for the Southdown crosses, but some difficulty was experienced in getting these lambs to sufficient weight for marketing. They tended to "finish off" at lighter weight than either of the other two crosses tested.

Certain observations were made by the shepherd and others that, while not experimental data, would have to be considered in any program of crossbreeding. The Leicester × Oxford ewes were impossible to keep in condition at the Central Experimental Farm, and were extremely short-lived. Their constant lack of condition was reflected in the low viability of their lambs, and the lack of finish of their lambs at marketing.

The closed faces of the Oxford × Shropshire ewes required frequent clippings about the eyes, and would make them less desirable for the general farm flock.

TABLE 15. CROSSBRED LAMB AND MARKETING DATA BY BREED OF SIRES.

Breed of sire		Shropshire	Suffolk	Southdown
Lambs—				
Born	No.	251	269	276
Birth weight	lb.	8·5	8·8	8·6
Gain to 28 days	lb.	13·1	14·4	14·0
Mortality to 28 days	%	13·1	20·0	10·5
Average weaning weight	lb.	67	76	68
Marketing data—				
Number	No.	205	200	225
Average age in days	days	207	187	209
A.D.G.	lb.	0·37	0·44	0·36
Average weight	lb.	83·5	89·1	81·9
Dressing percentage	%	45·5	47·0	49·2
"A" grade carcasses	%	76·0	74·0	94·0

The Leicester × Cheviot and Cheviot × Leicester crosses not only were superior in their over-all efficiency but were outstanding as mothers, the extra care given their offspring being at least partially reflected in their low mortality rate. Their productive life appeared to be longer than the other crosses tested.

While the North Country Cheviot crosses were too few in number to provide any conclusions, it was observed that they performed much like the Border Cheviot crosses, but were larger in size than the Border Cheviot crossbreds. G. M. Carman.

Performance and progeny testing of sheep

Until recent years there has been no clearly defined picture on the inheritance of rate of gain or efficiency of gain in sheep. Evidence presented has been inconclusive in nature, so no conclusions may be drawn.

Since the practice of selection on performance in beef cattle has proved to be successful, it would appear possible that selection on the same basis might be very worthwhile in sheep. An experiment to test these theories, and to obtain estimates of the heritabilities of the various economic factors was begun in 1953.

All purebred Shropshire ram lambs were left entire and run with the flock so no preferential treatment would be accorded. At the time of weaning the bottom one-third were culled on a weight basis, and the remainder placed on a 60-day feeding trial. At the termination of this trial the rams were graded and selections were made on the basis of an index comprised of rate of gain, classification, and weight at weaning.

The highest six rams on this index were assigned to breeding flocks. All rams retained were put on a further 70-day feeding trial after January 1, during which individual feeding was practised. Data were maintained on the progeny of the rams being tested. The results on all rams tested are presented in Table 16.

TABLE 16. INDIVIDUAL AND PROGENY PERFORMANCES OF RAM LAMBS ON TEST.

Weaning Weight	Indiv. performance A.D.G. on		Rank on index	Progeny performance		
	Test 1	Test 2		Lambing[1]	Lamb mortality	Av. corrected weaning wt.
lb.	lb.	lb.		%	%	lb.
67	0·37	0·64	15	.....	.....	.....
73	0·42	0·70	3	143·0	10·0	59·3
57	0·37	0·70	16	.....	.....	.....
67	0·45	0·54	8	.....	.....	.....
64	0·58	0·66	6	143·0	10·0	53·1
71	0·48	0·86	14	.....	.....	.....
79	0·44	0·50	2	129·0	39·0	53·1
69	0·53	0·73	9	.....	.....	.....
71	0·52	0·66	10	.....	.....	.....
61	0·55	0·57	13	.....	.....	.....
64	0·71	0·84	12	153·0	13·0	56·3
80	0·47	0·87	1	127·0	16·0	56·5
66	0·56	0·76	7	.....	.....	.....
75	0·40	0·74	4	138·0	9·0	59·3
83	0·48	0·62	11	.....	.....	.....
80	0·40	0·50	5	.....	.....	.....

[1] Rams with no data in this column were not utilized in the breeding flock.

The variability between individuals on test is very high. In a population of this nature selection can be used to great advantage, but data are so few in the present study that it is impossible to draw any conclusions on possible progress made. G. M. Carman.

Feeding Studies

Supplements for pregnant ewes

Previous experimental work showed that the most satisfactory ration for pregnant ewes was legume hay and oats. When non-legume hay was the sole roughage, some means of increasing the protein content of the ration was necessary. In recent years urea, a chemical nitrogen source, has received considerable attention as a protein substitute for ruminants and a project was instituted to investigate its utility in rations for pregnant ewes. The four experimental rations were:

Lot I Alfalfa hay + non-legume hay + oats.
Lot II Non-legume hay + oats + urea.
Lot III Non-legume hay + oats + urea + cobalt.
Lot IV Non-legume hay + oats + urea + molasses.

The data for the two years 1953 and 1954 are presented in Table 17.

TABLE 17. EWE AND LAMB DATA ON RATIONS FED TO PREGNANT EWES DURING LATTER PART OF PREGNANCY PERIOD

Ration		Lot I Alfalfa hay + non-legume hay + oats	Lot II Non-legume hay + oats + urea	Lot III Non-legume hay + oats + urea + cobalt	Lot IV Non-legume hay + oats + urea + molasses
Ewes—					
Number bred	No.	30	30	30	30
Number lambed	No.	29	28	28	28
Lambing percentage	%	130·0	133·3	140·3	137·1
Average Initial weight of ewes	lb.	128·0	123·0	122·2	122·2
Average weight of ewes at lambing	lb.	126·8	119·2	119·8	123·9
Lambs—					
Total births	No.	39	40	43	41
Average birth weight	lb.	9·4	9·2	8·9	9·0
Lamb mortality	No.	8	8	13	7
	%	20·5	20·0	30·2	17·1
Average weight of lambs at 28 days	lb.	23·9	21·5	19·6	21·6

From these data it would appear that urea can be utilized as a source of nitrogen for feeding pregnant ewes, but that the addition of molasses is desirable. While there are few differences exhibited in the four rations tested, the mortality rate of the group supplemented with molasses was less than that of the other three test lots.

It was observed in the barn that the molasses-fed lot had less trouble at lambing, and that their lambs were stronger and more robust than those in the other groups.

Further data are being secured on this project. S. R. Haskell, G. M. Carman.

Physiology Studies

The use of hormones for increasing multiple births in ewes

It would be of great value to the sheep breeder and to the research worker if a larger proportion of multiple births and a smaller variability of lambing percentages could be obtained by the use of hormone therapy.

In this experiment, which was conducted for three years, forty western-type ewes were selected, weighed, and allowed to run with a vasectomized ram each fall. Twelve days after being marked by the teaser ram, the ewes were placed with a fertile ram. Alternate ewes, marked by the teaser ram, received a single subcutaneous injection of 500 I.U. of equine gonadotrophin when they were placed with the fertile ram. The ewes were fed and managed as one flock. Only those ewes which conceived on first service to the fertile ram were included in the data.

TABLE 18. THE EFFECT OF HORMONE TREATMENT OF EWES ON THE LAMBING PERCENTAGES, BIRTH WEIGHTS, WEANING WEIGHTS, AND MORTALITY.

—	Number ewes lambed	Lambing percentage	Average birth weight	Average weaning weight	Mortality to weaning
	No.....	%	lb.	lb.	%
Year 1952—					
Control lot	18	139	9·9	.....	.....
Treated lot	17	165	9·0	.....	.....
Year 1953—					
Control lot	18	128	10·9	70·1	18
Treated lot	19	210	8·2	55·8	33
Year 1954—					
Control lot	14	133	10·3	58·3	20
Treated lot	13	123	10·0	55·9	25

While little or no difference appeared between the two groups in the number of ewes lambed, a large difference was evident in the lambing percentage as shown in Table 18. It is not known why the lambing percentage of the treated lot in 1954 was so low.

The results indicated that an injection of 500 I.U. of equine gonadotrophin on the 12th day of the breeding cycle had considerable effect in increasing lambing percentages. The average birth weight of lambs from the treated ewes was lower than that from non-treated ewes, and, on more limited data, the average weaning weight of the lambs from the treated ewes was lower.

SWINE

Breeding Studies

Inbreeding and prepotency

This project was started in 1946 in co-operation with the Production Service of the Department of Agriculture. The objective was to produce inbred lines of Yorkshires which would be economical to maintain and which could be used in crosses with each other and with outbred Yorkshires to produce market hogs of superior performance.

Three inbred lines were started and developed by the following procedure.

A boar and five or six of his closest available female relatives were chosen on the basis of Advanced Registry records as the foundation for a line. The boar was mated to his full sisters (or daughters) and from then on an inbreeding policy was followed with no outside blood being introduced. Four pigs were placed on Advanced Registry test from each of as many litters as possible. The remaining pigs in each litter were raised as breeding stock, and replacement gilts and boars were chosen from this group on the basis of their littermates' performance on the Advanced Registry test.

In addition, a fourth inbred line was developed from a cross between one of the previously mentioned lines and an inbred line developed in a similar manner at the Experimental Farm, Brandon, Manitoba.

During the past five years each of the lines mentioned above has been discarded as unsuitable for commercial use. As inbreeding progressed litter size and survival rate decreased until effective selection within the lines was extremely difficult. It has been concluded that the use of rapid rates of inbreeding in the development of lines is not desirable if intra-line selection is to remain effective. F. K. Kristjansson.

Development of a new breed

In 1947 a project was started to develop a new breed that would perform well in its own right and would cross with the Yorkshire to produce crossbred progeny superior to either parental breed. Since it was necessary to have a bacon-hog background for this breed and at the same time have it genetically different from the Yorkshire, foundation animals which were the result of crosses between the Danish Landrace and Chester White were secured from the Agricultural Research Center, Beltsville, Md., U.S.A. The original animals had about 50 per cent Landrace and 50 per cent Chester White "blood". Later, purebred Landrace boars were secured from Beltsville and were used in the development of the breed. At the present time the average composition of the breed is about 75 per cent Landrace and 25 per cent Chester White.

A Yorkshire herd is maintained for comparison with the new breed and crosses were made between the two breeds in 1954. Selection of breeding stock within the Landrace-Chester herd is based upon weaned litter size and upon rate and economy of gain as measured in a feeding test. In addition, two to four pigs from each litter are slaughtered in order to determine carcass quality.

Table 19 summarizes some of the data gathered from 1950 to 1954 on performance of the Landrace-Chester and Yorkshire herds and of the crosses made between them.

TABLE 19. AVERAGE PERFORMANCE OF LANDRACE-CHESTER, YORKSHIRE, AND CROSSBREDS, 1950-54.

Year	Season	Line	Number of litters	Av. number born alive	Av. number weaned	Av. 140-day weights	Av. carcass score
1950	S[1]	LC	5	9·4	7·6	.....	84
	F	LC	20	8·7	6·4	.....	61
1951	S	LC	15	10·3	3·8	103	73
	F	LC	22	9·6	7·1	133	57
1952	S	LC	14	8·4	2·1	118	60
	S	Y	14	8·6	5·4	91	74
	F	LC	27	8·1	5·9	139	56
	F	Y	16	9·1	5·1	136	.....
1953	S	LC	25	10·1	4·8	160	44
	S	Y	17	10·7	6·8	154	50
	F	LC	9	11·2	8·3	164	59
	F	Y	7	7·8	4·4	139	76
1954	S	LC	18	9·4	4·4	139	54
	S	Y	17	10·9	8·0	138	64
	S	LCxY	12	8·9	3·8	159	57
	S	YxLC	8	7·4	3·3	152	73
	F	LC	13	9·0	6·9	150	60
	F	Y	10	10·4	9·1	128	73
	F	LCxY	8	10·5	9·0	160	69
	F	YxLC	8	10·1	9·4	162	66

[1] S=spring, F=fall.

The performance of the Landrace-Chester herd is considered to be reasonably satisfactory with the exception of numbers weaned. The mortality rate from birth to weaning appears to be much higher than in the Yorkshire herd. There is no doubt that the Landrace-Chester and Yorkshire combine well in crosses. Growth rate in the crossbreds is considerably better than in either of the parental breeds. F. K. Kristjansson.

Production and Management Studies

Rhinitis affects rate of gain

During the spring of 1952 post-mortem examinations revealed that there was considerable rhinitis among pigs raised at the Central Experimental Farm, Ottawa. Plans were made to conduct a rhinitis survey on the complete herd in the fall of 1952 with the co-operation of the Animal Pathology Division of the Department, and, from the routine records taken in connection with the swine breeding work, to determine the effect of rhinitis upon weight for age.

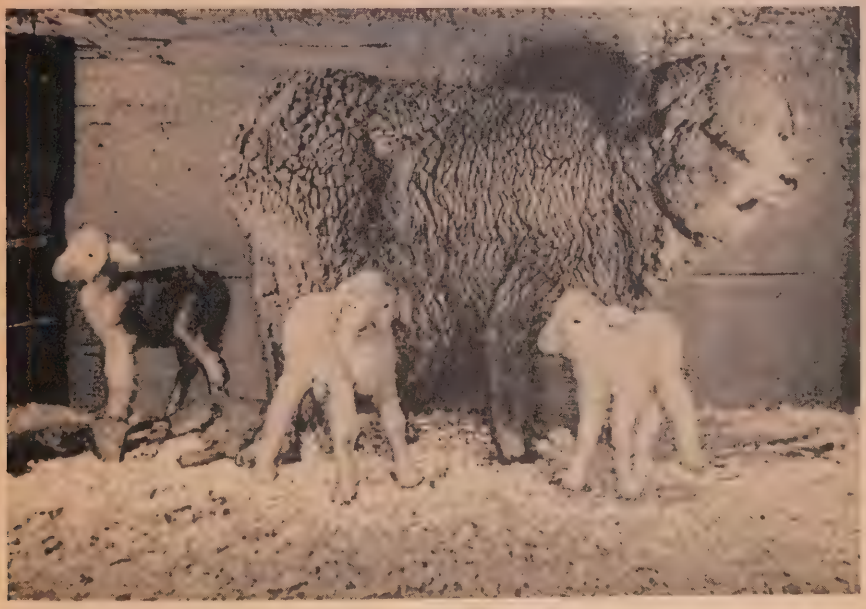
Two hundred and thirty-four pigs were examined *post mortem* for evidence of infectious atrophic rhinitis. Twenty-one per cent were found to be infected. Only three of the 27 dams which produced both infected and normal pigs had rhinitis lesions. Rhinitis-infected pigs were found to be significantly lighter at 56, 84, 112, 140, and 168 days of age than their normal litter mates. An analysis of birth weights of infected pigs and their non-infected litter mates indicates that pigs which are born light may be somewhat more susceptible to infection than their heavier litter mates. F. K. Kristjansson.

PASTURE AND TECHNIQUE STUDIES

The Determination of the Digestive Nutrient Consumption of Grazing Sheep

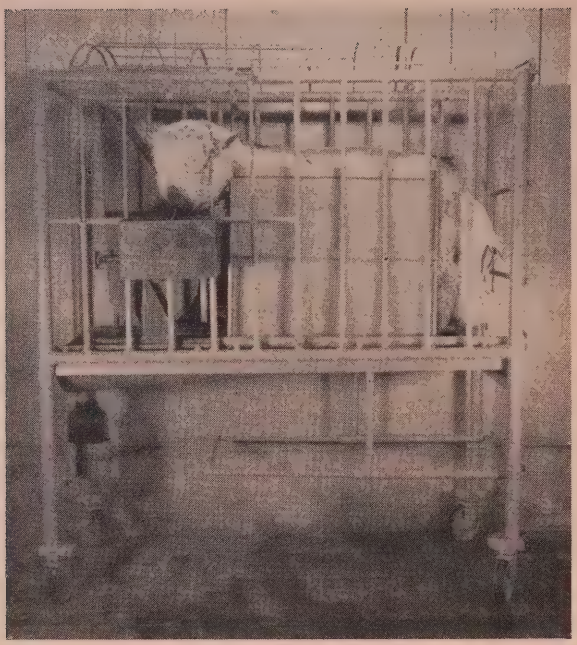
This experiment, conducted co-operatively with the Chemistry Division Science Service, was designed to give fundamental information on the nutrient requirements of grazing sheep for maintenance and gain.

Four groups of wethers were employed: control group; two grazing groups, one of which was restricted to the amount of grazing which would just maintain body weight (maintenance) and the other permitted to graze freely (maintenance plus gain); and a digestibility group which was confined to digestion cages. The control and grazing groups were slaughtered at the beginning and end of the grazing season, respectively, and the body tissues were analyzed for nitrogen and fat. Nutrient intake of the grazing groups was calculated from a combination of (1) dry matter output obtained by means of fecal collection equipment attached to the animals; and (2) digestion coefficients derived by feeding grass, similar in composition to that being grazed, to the digestibility group.



This ewe gave birth to five lambs after having been treated with hormone at breeding time. Two of the lambs were dead at birth.

This project was conducted for three successive years, 1950, 1951, and 1952. It was suspended in 1953 because there was evidence that new indicator techniques would facilitate obtaining the desired data with much less labor and expense. The data obtained are considered insufficient to give reliable estimates of maintenance and maintenance plus gain requirements of grazing sheep, hence are not summarized here. However, the 59 digestion trials conducted with the digestibility group over the three-year period have provided extremely valuable information for evaluating nitrogen as an internal indicator. This aspect is discussed in a following section. W. J. Pigden.



Sheep in digestibility crate and receiving clipped grass is used in developing new techniques for estimating the herbage consumption of similar animals grazing freely in the field.

Indicator Methods for Measuring Herbage Consumption

Studies at other institutions, during the period 1948-1951, indicated that reliable estimates of herbage consumption could be obtained for freely grazing animals by using indicators. Research to evaluate and adapt these methods to Canadian conditions was begun in 1952 and continued during 1953 and 1954 in co-operation with the Chemistry Division, Science Service. Studies were confined to two internal indicators, nitrogen and chromogen, and to one external indicator, chromic oxide.

Internal indicators are substances normally found in feces of grazing animals and the concentration of which is highly correlated with the digestibility of the consumed herbage. External indicators refer to inert substances which are administered quantitatively to the animal and a measure of their dilution in fecal material permits calculation of dry matter excreted. By using a combination of internal and external indicators the herbage consumption can be calculated.

Nitrogen as an internal indicator

A New Zealand researcher, R. J. Lancaster, developed a formula whereby organic-matter digestibility coefficients of consumed herbage could be estimated from the feces nitrogen. This formula was as follows:

$$\text{Organic-matter digestibility} = \frac{100\,n - 83}{n}$$

Where n = the nitrogen content of the ash-free feces
and 83 = a constant, calculated from a series of digestibility trials.

A total of 59 digestion trials carried out for the project, "The determination of the digestible nutrient consumption by grazing sheep", were used to calculate a constant for this series of trials. The constant differed considerably from that reported by Lancaster in that it was 92 instead of 83. When 92 was substituted as the constant in the above formula, estimates of organic-matter digestibility were obtained which were very close to those obtained conventionally. These data are summarized in Table 20.

TABLE 20. A COMPARISON OF ORGANIC-MATTER DIGESTIBILITY COEFFICIENTS OBTAINED CONVENTIONALLY AND FROM FECES NITROGEN.

Year	Number of digestion periods	Average organic-matter digestibility coefficients	
		Conventional	Feces nitrogen
1950	20	63·3	61·9
1951	21	69·8	69·6
1952	18	69·8	70·2

Since accurate estimates of organic-matter digestibility were obtained from fecal nitrogen it is evident that an extra group of animals is no longer necessary to provide digestibility data. The use of this internal indicator will permit the determination of the digestible nutrient intake by grazing sheep at a much lower cost than was previously possible.

Distribution of nitrogen in feces of grazing cows

The simplified application of internal indicators requires that estimates of the digestibility of herbage consumed by grazing animals be obtained from limited numbers of feces "grab samples", i.e., small portions of the total fecal excretion. A necessary pre-requisite to this sampling procedure is that the indicator be relatively uniformly distributed in fecal excretions. Hence, the distribution of fecal nitrogen in the feces of three dairy cows, grazing on a high quality, irrigated pasture, was studied. Samples of feces were taken from each animal every two hours from 8.00 a.m. to 8.00 p.m. and again at midnight and 4.00 a.m. for eight days. All samples were analyzed for nitrogen. The within day results are summarized in Table 21.

TABLE 21. THE DIURNAL DISTRIBUTION OF FECAL NITROGEN (PER CENT OF DRY MATTER) IN FECES OF DAIRY COWS. AVERAGE OF 8-DAY PERIOD.

——	A.M.				P.M.				
Time.....	4	8	10	12 noon	2	4	6	8	12 midnight
D.D. nitrogen.....	3·85	3·76	3·83	3·72	3·82	4·03	3·87	3·83	4·09

No differences in fecal concentration of nitrogen were observed between sampling hours or between animals. However, differences were observed between days. Thus, it appears that when nitrogen is employed as an internal indicator for high quality pastures, fecal samples can be taken from cows at any time during the day, but should be taken each day in order to obtain samples that are truly representative of a given period. Further studies are in progress to determine if the same considerations apply to medium and low quality pastures.

Chromogen(s) as internal indicators

J. T. Reid and others from Cornell University reported in 1952 that the fecal concentration of chromogen(s) for steers was highly correlated with the dry matter digestibility of various pasture herbages. These workers published a formula[1] for prediction of digestibility.

Studies at Ottawa in 1952 indicated that satisfactory estimates of digestibility could be obtained from fecal chromogen(s). Additional studies in 1953 showed that while the average digestibility coefficients obtained by the chromogen method were not greatly different from those derived conventionally (see Table 22) the variation between results for some individual trials was quite high. Hence this technique cannot yet be recommended for estimating the digestibility of herbage consumed by grazing animals.

TABLE 22. COMPARISON OF DRY-MATTER DIGESTIBILITY COEFFICIENTS DETERMINED CONVENTIONALLY AND BY [1]CHROMOGEN FORMULA

Animal	Number Trials	Average dry-matter Digestibility coefficients	
		Conventional	Chromogen (s)
Wethers	5	64·9	61·3
Steers	4	63·3	64·5

[1] $Y = 32{\cdot}74 + 0{\cdot}0168X + 8{\cdot}47 \log X$
Where Y = per cent of dry matter digested,
and X = units chromogen(s) per gm. dry feces.

Further studies of the fundamental chemistry of the chromogen(s) are in progress in order to define more specifically their function as internal indicators.

Chromic oxide as an external indicator

Two problems of practical significance connected with this indicator, which is used for estimating dry-matter excretion of grazing animals, were studied. These were the percentage recovery, and the diurnal excretion cycle, for both sheep and cattle.

Grazing wethers were each given 10 gm. chromic oxide (Cr_2O_3) daily, administered as a single dose, divided into 5-gm. portions and fed twice daily, or separated into six parts and given every four hours. Recoveries and diurnal excretion patterns of the Cr_2O_3 were determined by total collection and by taking grab samples of feces at two-hour intervals, respectively.

Average recoveries of the indicator were 101, 95, and 87 per cent for three four-day trials and 101 per cent for an eight-day trial. Frequency of administration had little or no effect on recoveries.

A marked diurnal excretion pattern, varying from 45 to 180 per cent for once-a-day and 65 to 135 per cent for twice-a-day dosing, was obtained during one four-day trial. The diurnal excretion patterns of two animals dosed twice daily were similar but the two animals on the once-a-day regime each exhibited a distinctly different pattern. When the indicator was administered six times daily during an eight-day trial, no evidence of a diurnal trend in the fecal concentration of Cr_2O_3 could be detected whereas a definite trend was found for control animals dosed only twice daily.

Grazing steers received the indicator in gelatin capsules either once (8.00 a.m.) or twice (8.00 a.m. and 4.30 p.m.) daily. The chromic oxide content of fecal grab samples taken at two-hour intervals, from 8.00 a.m. to 8.00 p.m., varied from 68 to 105 per cent of the four-day average for the two animals dosed once per day, and from 93 to 127 per cent for the two dosed twice per day.

Comparisons of diurnal excretion patterns found at different institutions showed that the diurnal pattern of steers dosed with chromic oxide once daily at Ottawa differed markedly from that observed at Cornell University for animals treated similarly. The patterns of the Ottawa groups dosed twice daily were similar to, but not identical with, those of hand-fed steers (Cornell) and cows (Washington) which received the chromic oxide once and twice per day, respectively.

This diurnal excretion cycle apparently was not readily reproducible at different institutions under various conditions and seemed likely to cause large sampling errors. An attempt to eliminate it was made at Ottawa by increasing the frequency of dosing with chromic oxide to six times daily. Under these conditions the concentration of the indicator in the two-hour fecal grab samples, taken from three cows for eight consecutive days, was very uniform and showed no evidence of a diurnal pattern.

These studies have indicated that, with the exception of the tendency for chromic oxide to be excreted in a diurnal pattern, it is a very useful indicator. Since manual administration of the indicator to grazing animals every four hours is impractical, some means of providing a slow and continuous release of the chemical into the rumen contents is now being sought. W. J. Pigden.

Factors Affecting Body Weights of Cattle on Pasture

One of the most practical procedures for measuring pasture production is based on live weights. An important limitation of this procedure is the great variability which is frequently encountered in day to day cattle weights. Some of the factors involved in this variation were studied.

The daily weights of twenty milking cows and twelve yearling heifers on a "fresh daily" versus "free range" grazing management experiment were taken for about 150 days beginning before the animals went to pasture in the spring of 1953. An average loss of 6·4 per cent of the live weight was recorded for the twenty cows the first six days on pasture before they started to gain weight. The twelve heifers lost an average of 11·5 per cent of their live weight within the first ten days on pasture. These data demonstrate the need for an adequate pre-pasture conditioning period. It was also noted that daily weight variations were much greater for individual animals on the "fresh daily" plots than for those on "free range".

Further studies concerning the cause of the heavy weight losses were made in 1954. Daily weights for a group of dairy steers fed on a hay and grain ration were compared with those of a similar group maintained on freshly clipped herbage during a two-week pre-pasture conditioning period. A second comparison was made during two weeks post-pasture. The grass-fed group lost over three per cent of their weight within the first two days after grass feeding was begun in the barn and lost an additional three per cent when placed on pasture. The group on the dry ration lost seven per cent of their weight during the first two days on pasture. These studies indicate that approximately fifty per cent of the post-pasture losses of these cattle was due to losses of rumen fill. W. J. Pigden, V. J. Miles.

DAIRY RESEARCH

Rind Rot or "Wet Ends" in Canadian Cheddar Cheese

This troublesome defect was investigated and its causes outlined. The defect is contributed to by: (1) surface mold growth, particularly on the ends of the cheese; (2) improper rind formation; (3) wet headings and boxes; (4) by paraffining cheeses which are not thoroughly dry. Prevention of the defect requires proper attention to each of the above contributing factors. This work was reported in The Canadian Dairy and Ice Cream Journal, Volume XXIX, Number 12, 1950. Earlier related studies were; (1) "Mold Control in the Cheese Factory Curing-Room", Department of Agriculture Publication 854, and (2) "Cracked Rinds in Cheddar Cheese", published in The Canadian Dairy and Ice Cream Journal, Volume XXIX, Number 3, 1950. C. A. Gibson.

Fruity Flavor in Cheddar Cheese

It has been demonstrated that such flavour defects as "unclean", "slightly fruity", and "fruity" can be reproduced experimentally in cheddar cheese by the addition of yeasts and ropy-milk bacteria to the cheese milk. While the extent of contamination with yeasts and ropy-milk bacteria in cheese-factory milk supplies is not known, their presence in large numbers suggests that these organisms are a cause of the sporadic or scattered occurrence of "not clean" and "fruity" flavors in commercial cheddar cheese. C. A. Gibson.

Packaging Rindless Cheddar Cheese

Press cloths are essential to the formation of a close surface on cheese during pressing. It has been demonstrated that paper press cloths leave the surface of 20-pound blocks of cheese in a better condition for wrapping in Pliofilm or other plastic wraps, than do the normal muslin press cloths. However, paper press cloths must be discarded after single service and are not economical. C. A. Gibson.

Studies on the Efficiency of Milk Strainers

Filtration of milk through a single service cotton fiber disk is common dairy farm practice. The filter disk is normally supported by a perforated plate in the strainer. It was demonstrated that a wire screen placed in the strainer beneath the cotton disk greatly increased the rate at which the milk would pass through the strainer. The advantage afforded by the wire screen beneath the filter disk became more pronounced as the amount of sediment in the milk increased. C. A. Gibson.

ORGANIZATION OF LIVESTOCK RESEARCH WITHIN THE EXPERIMENTAL FARMS SERVICE

This progress report has dealt primarily with the research work conducted by the Animal Husbandry Division staff at the Central Experimental Farm, Ottawa. However, this represents only a part of the total livestock research done in the Experimental Farms Service. The remainder is carried out on branch Experimental Farms throughout Canada and is reported in the publications of the individual Farms.

The Ottawa staff has a direct responsibility for guiding and co-ordinating the branch unit and Central Farm programs to ensure maximum benefit to Canadian producers from the funds and facilities available. Farm animals of

one or more classes are maintained at 28 branch Farms and in addition there is a special fur animal Farm at Summerside, P.E.I. The level of work varies at these Farms depending on their facilities and staff but broadly speaking all animals are used for obtaining research or observational data. Each Farm is expected primarily to consider problems of a local nature but generally the results obtained from research have more than local application.

On local problems only single Farms are involved but on regional or national problems several Farms may be co-ordinated for more effective attack on the problems. Co-operative work is especially important in breeding research. The dairy cattle breeding research program, which includes most of the dairy herds in the Farms Service, is an example of this procedure. The program is co-ordinated from Ottawa but individual Farms have had an active part in developing the program and all will take an active part in its execution. Data collection has been standardized and data are sent to Ottawa where mechanical tabulation is available thus permitting the main analyses to be done efficiently. In addition, individual Farms are expected to make subsidiary studies of data from their own herds.

The details of organization for the beef cattle, sheep, and swine breeding research programs differ somewhat but co-ordinated efforts for maximum use of facilities is the underlying principle.

The development of the whole research program and the maintenance of balance in the work is facilitated by individual visits among the Animal Husbandry staffs and periodic staff conferences. Frequent discussions and exchange of ideas ensure that problems receive consideration and study as they arise and permit a marshalling of facilities to solve them in an effective manner. The wide scope of the research work conducted by the Animal Husbandry Division at the various Farms is indicated by the following statement on major project fields of work:

Major Project Fields of the Animal Husbandry Division

1. *Animal breeding.* Methods of testing and selection; systems of breeding; improvement of existing breeds and the development of new breeds; application of artificial insemination.
2. *Animal nutrition.* Study of: rations and methods of feeding; evaluation of pastures, hays, silages, and other feeds, including crop by-products; nutrient requirements of various classes of stock; development of new techniques for measuring pasture productivity.
3. *Production and management.* Evaluation of: types of buildings; management practices of livestock when housed and on pasture; systems of raising and producing various classes of stock.
4. *Physiology.* Studies of reproductive failures; hormone balances affecting reproduction; physiological norms of young pigs.
5. *Animal products.* Dairy processing; wool technology.

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Hough, W. H. and S. B. Williams. The shepherds calendar. Pub. 854, 1952.

Kalbfleisch, W., V. S. Logan, and J. W. White. Loose housing of dairy cattle. Pub. 874, 1952.

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EXPERIMENTAL FARMS SERVICE

Director, C. H. Goulden, B.S.A., M.Sc., Ph.D., LL.D.
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